● PRINTER RUSH ●
(PTO ASSISTANCE)

Application :	10/032694	**Examiner :**	Sotomayor	**GAU :**	3662
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[RUSH] **MESSAGE:** There is a black box on the bottom of page 15 which I believe should be an equation. Please advise.

Thank you.

[XRUSH] **RESPONSE:** The equation found in paragraph [0069] in PGPub US 2003/0189510 A1 (attached) and should read

$DOF \approx \frac{1.34 s'}{\lambda}$

Thank you.

INITIALS: gf

NOTE: This form will be included as part of the official USPTO record, with the Response document coded as XRUSH.

REV 10/04

[0063] Frame rate adjusted on the embodiment of **FIG. 6** by increasing receiver numbers to allow mechanical feasibility.

[0064] Using a linear array of the type shown in **FIG. 2** gives

TABLE 1

Desired spot size/ mm	Frequency/ GHz	Aperture/ m	No of Receiver elements	Thermal sensitivity/ K
20	90	1.01	930	0.35
50	90	0.40	372	0.22
100	90	0.20	186	0.16
20	30	2.78	930	0.35
50	30	1.11	372	0.22
100	30	0.56	186	0.16

[0065] Using the scanned system as illustrated in **FIG. 3** gives:

TABLE 2

Spot size/ mm	Frequency/ GHz	Side frame rate/Hz	Top frame rate/Hz	Aperture/ m	No of Receiver elements	Side Thermal sensitivity/ K	Top Thermal sensitivity/ K
20	90	5.3	7.1	1.01	465	0.62	0.62
50	90	5.3	7.1	0.40	186	0.39	0.39
100	90	5.3	7.1	0.20	93	0.28	0.28
20	30	5.3	7.1	2.78	465	0.62	0.62
50	30	5.3	7.1	1.11	186	0.39	0.39
100	30	5.3	7.1	0.56	93	0.28	0.28

[0066] Using the scanned system as illustrated in **FIG. 6** gives:

TABLE 3

Spot size/ mm	Frequency/ GHz	Side frame rate/Hz	Aperture/ m	Rx per array	Total no. of Receiver elements	Side Thermal sensitivity/ K	Top Thermal sensitivity/ K
20	90	14.9	1.01	60	180	1.48	1.26
50	90	35.7	0.40	10	30	1.45	1.24
100	90	59.5	0.20	3	9	1.32	1.13
20	30	5.4	2.78	166	498	0.89	0.76
50	30	13.2	1.11	27	81	0.88	0.75
100	30	25.5	0.56	7	21	0.86	0.74

[0067] In these tables, the spot size is the half power beamwidth of the antenna system, as measured at the focal distance. The top and side frame rates are rotation rates of the scan mechanism for the antennas looking into the top of the container and looking into the side of the container respectively. The aperture is the optical aperture of the antenna system. The thermal sensitivity is the system noise level.

[0068] It can be seen that the latter embodiment uses the least number of receiver elements in most cases, thus in general will be preferred in terms of cost. Noise performance, although not as good as the other systems, is satisfactory, as the contrast in a lorry container has been measured, and is of the order 60K, giving a signal to noise ratio of 16-19 dB or so.

[0069] The depth of field (DOF) obtainable by these systems again varies according to desired resolution and frequency of operation. If s is the spot size and A is the operating wavelength, from diffraction theory,

$$\boxed{DOF \approx \frac{1.34s^2}{\lambda}}$$

insert for black box on p. 15 of spec

[0070] In practice the useable DOF without unduly compromising image quality is around four times greater than that predicted by the above equation. In many circumstances the DOF may be such that not all of the inside of the container is visible, even when viewed from both sides and from above. To counter this, an embodiment shown in **FIG. 7** has two layers of receivers **(21,22)** arranged at different focal positions within the receiver system. Thus, two different distances **(21', 22')** will be in focus at any one time, and twice the volume of the container **(4)** can be seen at any one time. Although shown on a scanning receiver, the method is equally applicable to a fixed view receiver such as that shown in **FIG. 2**.

[0071] For satisfactory imaging, there is a limitation on the speed at which the container can pass the receiver. The speed should be sufficiently low such that successive cycles of the scan system can sample the radiation at a suitable rate, so that all gaps—if any—in the scan pattern during one cycle are sampled during further (or previous) scan cycles. Given a spot size s (half-power antenna beamwidth), a scan rate F, an array of n receive elements along the direction of movement and a vehicle speed u, then

Using the scanned system as illustrated in Figure 6 gives:

Spot size /mm	Frequency /GHz	Side frame rate /Hz	Aperture /m	Rx per array	Total no. of Receiver elements	Side Thermal sensitivity /K	Top Thermal sensitivity /K
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In these tables, the spot size is the half power beamwidth of the antenna system, as measured at the focal distance. The top and side frame rates are rotation rates of the scan mechanism for the antennas looking into the top of the container and looking into the side of the container respectively. The aperture is the optical aperture of the antenna system. The thermal sensitivity is the system noise level.

It can be seen that the latter embodiment uses the least number of receiver elements in most cases, thus in general will be preferred in terms of cost. Noise performance, although not as good as the other systems, is satisfactory, as the contrast in a lorry container has been measured, and is of the order 60K, giving a signal to noise ratio of 16-19dB or so.

The depth of field (DOF) obtainable by these systems again varies according to desired resolution and frequency of operation. If s is the spot size and λ is the operating wavelength, from diffraction theory,